

# Planning for Planetary Science Mission Including Resource Prospecting, Phase II

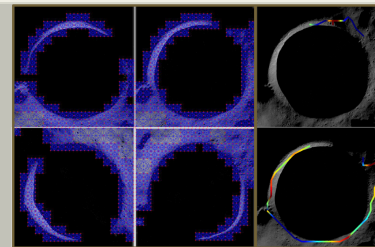
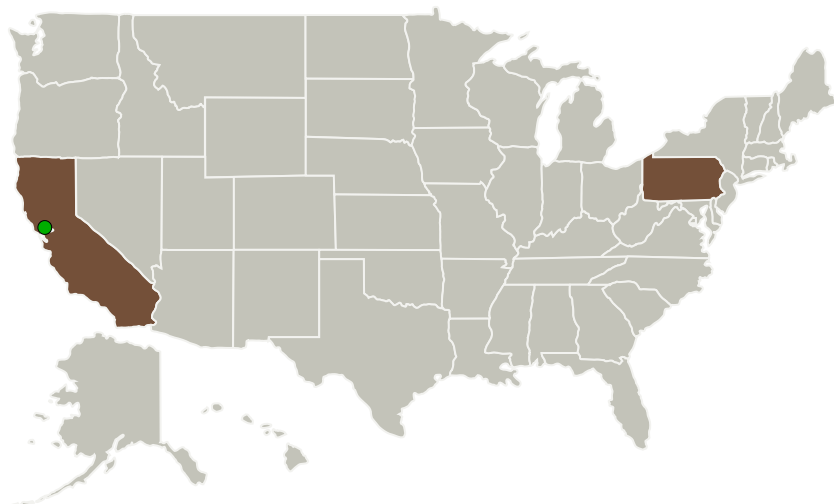
Completed Technology Project (2014 - 2016)



## Project Introduction

Advances in computer-aided mission planning can enhance mission operations and science return for surface missions to Mars, the Moon, and beyond. While the innovations envisioned by this program are broadly applicable, they serve an immediate and urgent need for missions to prospect for volatiles at the lunar poles (i.e., the NASA Lunar Resource Prospector Mission, currently in Phase A). These missions must be rapid and precise, covering multiple kilometers in approximately 10-12 Earth days to complete mission objectives in one lunar light cycle. This calls for the ability to drive intentionally and efficiently to precise drilling destinations. Polar operations encounter low angle lighting; this creates shadows which confront robot operations with challenges in power production, thermal control, and operator situational awareness. This demands robust path planning for efficient mission planning and execution. The proposed work develops a computer-aided mission planning tool that balances the competing demands of efficient routes, scientific information gain, and rover constraints (e.g., kinematics, communication, power, thermal, and terrainability) to generate and analyze optimized routes between sequences of locations. Planner-computed statistics about the set of viable paths enable mission planners, scientists, and operators to efficiently select routes considering a range of priorities including risk, duration, and science return. This planner will serve an invaluable role in preplanning missions and as a tool for rapidly understanding the impact of changes in mission profile during the mission execution.

## Primary U.S. Work Locations and Key Partners



(Left) Planning routes based on resource costs at different times of day. (Right) Alternate paths between waypoints generated based on start time

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Organizations Performing Work	Role	Type	Location
Astrobotic Technology, Inc.	Lead Organization	Industry	Pittsburgh, Pennsylvania
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Pennsylvania

## Project Transitions

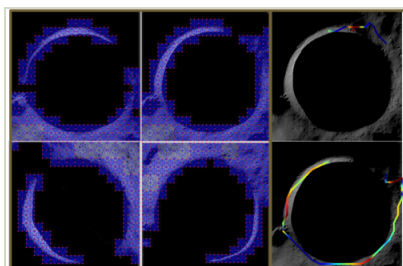
▶ **August 2014:** Project Start

✓ **December 2016:** Closed out

### Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/137610>)

## Images



(Left) Planning routes based on resource costs at different times of day. (Right) Alternate paths between waypoints generated based on start time

### Briefing Chart Image

Planning for Planetary Science Mission Including Resource Prospecting, Phase II (<https://techport.nasa.gov/image/136911>)



### Final Summary Chart Image

Planning for Planetary Science Mission Including Resource Prospecting, Phase II Project Image (<https://techport.nasa.gov/image/134446>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Astrobotic Technology, Inc.

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

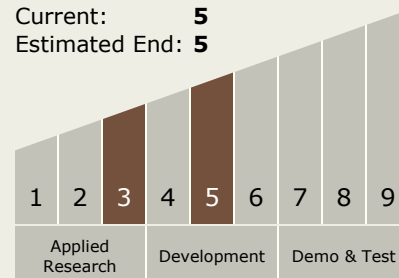
Carlos Torrez

### Principal Investigator:

Kevin Peterson

## Technology Maturity (TRL)

Start: 3  
Current: 5  
Estimated End: 5



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## Technology Areas

### Primary:

- TX10 Autonomous Systems
  - └ TX10.2 Reasoning and Acting
    - └ TX10.2.4 Execution and Control

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System